

Application Serial No.: 10/623,243
Attorney Docket No.: 0140111

REMARKS

Claims 1, and 3-20 were pending prior to the present amendment and response. By the present amendment and response, claims 1, 9, and 16 have been amended to overcome the Examiner's objections and claim 17 has been canceled. Thus, claims 1, 3-16 and 18-20 remain in the present application. Reconsideration and allowance of outstanding claims 1, 3-16 and 18-20 in view of the above amendments and the following remarks are respectfully requested.

A. Rejections of Claims 1 and 3-20 under 35 USC §102(b)

The Examiner has rejected claims 1 and 3-20 under 35 USC §102(b) as being anticipated by U.S. Patent Number 6,338,985 to Greenwood (hereinafter, "Greenwood"). For the reasons discussed below, Applicants respectfully submit that the present invention, as defined by amended independent claims 1, 9, and 16, is patentably distinguishable over the cited reference.

As disclosed, the present invention includes a surface mount component (also referred to as "SMC"), having first and second terminals, and situated over a substrate. First and second pads are situated on the substrate and are coupled to the first and second terminals, respectively. As part of the solution to the shortcomings of the conventional technology, solder mask trench 124 is formed under a surface mount component, such as SMC 102 or SMC 302, although the region under the SMC is not generally solderable and wherein, in any event, no soldering is to take place. Thus, solder mask trench 124 is

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formed where, in the absence of the present invention, no solder mask opening would be formed. Indeed, since the invention does not require complex changes to the existing technology, the disadvantages of the existing technology in having voids in molding compounds under an SMC are overcome without increasing manufacturing costs. Thus, as a part of the teachings of the present invention, a solder mask trench is formed under the SMC, and the trench thus formed and the resulting moldable gap are filled with a molding compound.

More particularly, as shown in, for example, Figure 1 of the present application, solder mask trench 124 is formed within, i.e. between portions of, solder mask 112. By forming solder mask trench 124 underneath the surface mount component and within solder mask 112, moldable gap 125, with an increased height 128, is advantageously formed and is substantially larger than a conventional moldable gap. By contrast, in a conventional structure, solder mask 112 would fill the region between pads 106 and 108 underneath the surface mount component. As a result, a conventional moldable gap that would be formed between solder mask 112 and the bottom surface of the surface mount component would have a reduced height 130, as shown in Figure 1 of the present application.

Thus, by forming solder mask 124 within, i.e. between portions of, solder mask 112, embodiments according to the present invention advantageously achieve a significantly larger moldable gap, having height 128, that improves molding compound flow underneath the surface mount component and, consequently, minimizes void

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formation underneath the surface mount component. As a result, embodiments according to the present invention advantageously minimize the risk of shorting between the terminals of the surface mount component during, for example, reflow assembly. Thus, among other advantages, the reliability of the surface mount component is significantly increased.

In contrast, Greenwood provides a method for making chip size semiconductor packages and more particularly, for making low cost memory packages. Accordingly, the Greenwood disclosure sets forth steps that pertain to electrically connecting a semiconductor die to metallization on an insulative substrate. Furthermore, Greenwood teaches that one or more vent openings through the substrate and solder mask can be used to displace the air in the gaps trapped between the die and the substrate and solder mask as underfill material is injected into the package assemblies.

The vent used in Greenwood, however, is functionally different from the solder mask trench situated beneath a surface mount component as disclosed in the present application. As seen in Figure 6, Greenwood discloses an opening that passes down and through solder mask layer 34 *as well as through insulative material 15* in order to allow the underfill material to force out any air trapped between the die and the layers below. See, for example, Greenwood, column 6, lines 7-19. Thus, the vent in Greenwood must completely penetrate the substrate 12.

The solder mask trench used in the present invention, however, does not penetrate the substrate. See, for example, Figure 1 of the present application. Independent claims

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1, 9 and 16 have been amended to amplify this distinction and now recite that "said solder mask trench is situated over a top surface of said substrate." Consequently, this aspect of the invention as defined by amended independent claims 1, 9, and 16 results in various advantages over related art, such as Greenwood. For example, according to the present invention, a particular multi-chip module package including various surface mount components can be optimized to facilitate the flow of underfill material by simply patterning the solder mask to incorporate various trenches in the solder mask below respective surface mount components. Moreover, the substrate does not have to be penetrated or redesigned.

For the foregoing reasons, Applicants respectfully submit that the present invention as defined by amended independent claims 1, 9, and 16 is not taught, disclosed, or suggested by the art of record. As such, the claims depending from independent claims 1, 9, and 16 are, *a fortiori*, also patentable for at least the reasons presented above and also for additional limitations contained in each dependent claim.

B. Conclusion

Based on the foregoing reasons, the present invention, as defined by amended independent claims 1, 9, and 16, and the claims depending therefrom, is patentably distinguishable over the cited art. Thus, outstanding claims 1, 3-16 and 18-20 are patentably distinguishable over the cited art. As such, and for all the foregoing reasons,

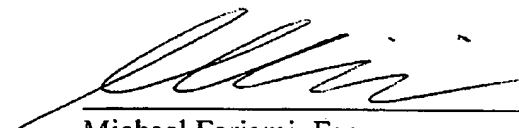
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an early Notice of Allowance directed to all claims 1, 3-16 and 18-20 remaining in the present application is respectfully requested.

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Respectfully Submitted,
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